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A preliminary report on the subjective comparison of medium-range forecasts produced by ECMWF and the Meteorological Office.

by

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FH24

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by J Findlater

Introduction

The European Centre for Medium Range Weather Forecasts (ECMWF) began issuing forecasts for up to seven days ahead towards the end of August 1979. These forecasts are produced daily, except on Fridays and Saturdays, from a data time of 1200 GMT, and are received at Bracknell in the form of 1000 mb and 500 mb contour prognoses which are utilized by the medium-range forecasters in Met O 2.

Since early in September 1979 a detailed examination has been made in Met O 11 of the ECMWF forecast issued each Monday, in comparison with the six-day forecast produced by the Meteorological Office 10-level Octagon model from the same data time, and with the actual weather. Subjective assessments are made of the guidance value which the forecasts contain for the North Atlantic and European area and, separately, for the United Kingdom area.

Objective assessments by error statistics from the ECMWF model are published monthly, (ECMWF (1979a)). Error statistics for the Octagon 6-day forecasts are summarized monthly and copies are available in Met O 2b.

1. The numerical models

The ECMWF model is described in ECMWF Technical Reports (1977, 1979b) to which the reader should refer for details. In brief, the ECMWF model is in σ co-ordinates, has global coverage at 15 levels, and uses a latitude-logitude grid of approximately 1.8 degrees.

The Octagon model uses 10 levels in steps of 100 mb from 1000 mb, and is limited to areas north of about 15 degrees North. The grid length is approximately 300 Km, exactly so at 60 degrees North. Details of the model are given by Burridge and Gadd (1977).

The two models are very different, and have nothing in common with each other.

2. Chart format

ECMWF currently produces global analyses and forecasts from a data time of 1200 GMT from Sundays to Thursdays inclusive, for up to ten days ahead. The issues received at Bracknell are for the North Atlantic and European sector only, and for up to seven days ahead. Forecasts for days 8, 9 and 10 are considered to be too unreliable to be issued at the present time. The issues received at Bracknell are the 1000 mb contour prognoses with 850 mb temperatures superimposed, and the 500 mb prognostic contours and isotherms, from Days 0 to 7.

These charts are on a scale of 1:30 million. Examples of the issues for Day 3 from 26 November 1979 are shown in Fig. 1, necessarily on a smaller scale.

Arrangements were made with Met O 2b for the output from the Octagon 10-level model up to Day 6 to be in a similar format to facilitate comparison of the two

sets of forecasts. However, the Octagon surface pressure charts, with 850 mb isotherms superimposed were used instead of the 1000 mb contour charts.

Contour intervals at 500 mb on both sets of forecasts were at intervals of 4 dm up until the onset of winter in 1979 when the interval was increased to 8 dm to avoid blurring on facsimile transmissions. The ECMWF contours of 1000 mb height are at 4 dm intervals and the output from the Octagon model was adapted to give surface (MSL) isobars at corresponding 5 mb intervals. Isotherms are at 4°C intervals at both the 850 mb and 1000 mb levels.

From 14 January 1980 the Octagon model was run to Day 7, on Mondays only, in order to obtain forecasts exactly comparable with those from ECMWF. To date, however, insufficient data have been accumulated for the Day 7 Octagon forecast to warrant their inclusion in this report.

3. Model characteristics

3.1 The Octagon 10-level model.

The Octagon model displays certain characteristics, some of which are common to other numerical models. Many of these characteristics have become well-known since the model became operational in 1972, and have been summarized by the Meteorological Office College (1978). These are:-

a) The model will handle synoptic features which have dimensions greater than about 2 or 3 grid lengths. For systems smaller than this the model will have difficulty in analysing and predicting their development.

b) Most models are biased towards zonal flow but are slow with phase speeds of troughs and ridges, and in detecting the early signs of development. Meridional developments may be underestimated.

c) Central pressures of lows are not deep enough and models often fail to turn developing depressions to the left.

d) The Octagon is good with trough disruption and changes of type but is often slow in forming cut-off lows.

e) The models tend to fill old lows and weaken old highs too quickly.

f) The model's own continuity can be an important factor in establishing confidence with the forecaster about expected developments.

During the comparison reported here several other characteristics of the Octagon model have been noticed. These are deduced from a six-month period only but they are noted below so that future forecasts can be examined for recurrences. The additional characteristics are:-

g) The model analysis and forecast schemes do not analyse or predict tropical storms from the Caribbean well, probably because of proximity to the boundary and the small scale of the systems. After becoming extra-tropical depressions they are handled in the same way as other systems.

h) The 500 mb contain gradients generally decrease during the 6-day forecast and become much too weak by the sixth day. This is especially marked in the eastern Atlantic sector and over Europe.

i) The model often runs about one day slow by Day 6. This characteristic may be linked to that of h) above.

j) Temperatures at 850 mb in the Azores anti-cyclone, Iberia, North Africa and the Mediterranean area are often 4-8°C too low by Day 6. The model appears to allow insufficient warming by subsidence and connection, especially the contribution from the release of latent heat in the latter process, in these areas.

k) 500 mb contour heights are often too low over the areas noted in j) above.

l) 850 mb temperatures are generally too warm in frontal troughs and too cold in mobile ridges. Indeed, one particularly noticeable feature is that the axis of a cold trough in the 850 mb isotherms is usually co-incident with the ridge axis, and remains so during the forecast period. The normal process of the thermal trough axis moving to the east of the surface ridge axis is not often reproduced by the model.

m) New depressions forming off the eastern seaboard of the US do not deepen quickly enough in the early stages, and as a consequence are often steered to the east or northeast and absorbed by the old parent low. In reality the lows often deepen quickly and eventually absorb the parent low.

3.2 The ECMWF model

The ECMWF model has only run operationally for a few months and little is known at present about its characteristics. However, the limited experience so far indicates the following characteristics:-

a) The model is not always good at predicting a change of weather type.

b) Depressions tend to be over-developed and are often incorrectly forecast to become large slow-moving features near Iceland by Days 5-7. Sometimes two large depressions are predicted to co-exist in rather close proximity, and this is seldom observed to occur.

c) The model produces meridional flow too readily.

d) Tropical depressions or cyclones are not handled very well.

e) Tracks of depressions and anticyclones are sometimes predicted to be at a somewhat lower latitude than the actual tracks.

f) In association with e), the axis of the 500 mb jet is often predicted to be at too low a latitude.

g) The model does not predict Mediterranean depressions very well, although cold air incursions into the area are usually well-timed.

h) The model occasionally produces 500 mb contour and isotherm patterns around depressions which appear to be inconsistent with the further predicted movement of the system. This characteristic has been noticeable only at Day 4 and later forecasts. An example is given at Appendix 'A'.

i) Occluding depressions are not turned sufficiently to the left of their original tracks. (See Appendix 'A').

j) New depressions forming off the eastern seaboard of the United States often develop too quickly and absorb the parent low too readily (c.f. 3.1(m))

3.3 The Octagon and ECMWF models.

A particular characteristic which has emerged during this examination has been the capability of both models to follow individual features such as a cold front or a trough on many occasions from Day 0 to Day 6 and 7, and to predict its development in a realistic fashion. This does not always happen, of course, but it has occurred with sufficient regularity to demonstrate the capability of both models to deal with smaller-scale features once they have been correctly analysed. Earlier it had been thought that only the very broad features of development would be predictable out to Day 6 and 7.

A summary of the characteristics of both models, listed in Sections 3.1 and 3.2, is given in abbreviated form in Table 1.

4. Assessment scheme

The main aim of the project is to assess the information content of the forecasts from one to six or seven days ahead, and hence their value as guidance to forecasters. However, there are many difficulties in deciding on the information content of a forecast which may differ according to whether the scale being considered is continental, national, regional or local. Also, the guidance value may be dependent on the meteorological parameter to be predicted; for example, a good forecast of precipitation liklihood may not necessarily accompany a good forecast of the associated wind velocity or temperature. Furthermore, much depends on the interpretation of a numerical forecast by an individual forecaster, his skill, and his knowledge of the strengths and weaknesses of the numerical models.

In view of these difficulties a very simple and general assessment scheme of the weather type has been adopted for this first phase of the comparison. It is based on the scheme used in the Central Forecasting Office, i.e.:-

Assessment of guidance value of forecasts

A - Good Guidance

B - Did not lead to any major error

C - Misleading in some important respect.

The forecasts for the surface (or 1000 mb) and 500 mb levels are assessed in this way for the whole area of the North Atlantic and Europe and, separately, for the United Kingdom.

Forecast classification depends to some extent on the day to which the forecast

refers as, for example, a moderate displacement of a particular feature from its actual position on Day 1 or 2 is usually a more serious error than the same displacement on Day 6, when the forecast can be regarded as a more general indication of the position and tracks of synoptic systems. Three examples of assessments are given at Appendix 'B'.

Hopefully, experience with this simple scheme will lead to an improved method of assessment, but it is too early to adopt some of the suggestions which have been made and which are listed at Appendix 'C'.

At the present time only one pair of forecasts is marked each week, these are the forecasts issued each Monday from a data time of 1200 GMT.

Additional to these subjective assessments a zonal and a meridional index are measured over the United Kingdom on each forecast 500 mb chart, for comparison with the actual value. The zonal index is measured from 50°-60°N at 5°W and the meridional index from 13°W to 4°E at 55°N. Insufficient measurements are available at present to draw any conclusions from these indices; a fairly long series of observations will be required to detect any significant trends in the difference from actual values during the forecast period. The subjective assessments of the guidance value of the forecasts were always made by the same forecaster and thus a personal bias may be present in the assessment scheme. To obtain some measure of the bias one forecast was assessed by a panel of seven forecasters and their individual classifications averaged to obtain a group assessment for comparison with that of the usual assessor. The results showed that the group assessment was almost always (50 cases out of 52) the same as, or slightly less than, that of the single assessor. Subsequent discussion revealed that the single assessor was taking a broader view of the synoptic situation after about Day 4 and on the longer time scale giving less

weight to detail than most of the group. The comparison of marks awarded by the group and by the single assessor are at Appendix 'D'.

An experiment was made, for a few cases, where on Day 0 two forecasters independently assessed the weather elements to be expected on Days 1 to 7 over England south of a line from the Bristol Channel to the Wash. The elements forecast were wind speed and direction, precipitation, and maximum temperature. An example of one such assessment is at Appendix 'E'. It is evident that there can be significant differences in the interpretation of forecast contour patterns by individual forecasters. Also, the verification of these forecasts required a third forecaster to assess the actual weather over the area on each of the seven days. His assessment is shown by the shaded areas in Appendix 'E', but another forecaster would not necessarily have assessed the actual weather in the same classes.

The experiment shown at Appendix 'E' emphasises the high degree of subjectivity involved when attempts are made to interpret the forecast contour patterns in terms of weather elements. It also suggests that some modifications should be made to future experiments of this kind. Firstly, the area chosen was that of England south of a line from the Bristol Channel to the Wash; this is too large an area and one within which so many variations take place that a smaller area would have been better. For future studies of the kind shown at Appendix 'E' a smaller area, or a location, should be chosen to facilitate classification and verification. Secondly, the choice of classes of the various weather elements should be carefully re-considered.

5. Comparison of models.

The overall performance of the two models is shown in Fig. 2 where the assessments are given separately for the surface level and 500 mb level, for the whole area and for the United Kingdom

The main feature of Fig. 2 is that there is really little difference in the average performance of the two models. This is a little surprising in that the Octagon uses 10 levels and extends only to about 15°North, whereas the ECMWF model utilizes 15 levels and covers the whole globe. Also, the ECMWF model has a later cut-off time for data entry. On the other hand, the Octagon model input is subject to human intervention in scrutiny of observations whilst the ECMWF model has no such facility, all quality-control of observations being carried out automatically.

A closer scrutiny of the data in Fig. 2 indicates a slight tendency for the ECMWF model to produce better forecasts of the 500 mb contour field at Days 5 and 6, whilst at the surface level the Octagon model achieves fewer 'C' marks at Days 5 and 6 than does the ECMWF model. It cannot be concluded, however, that these indications are of real value because of the small number of cases, and the subjectivity of the assessment scheme.

Fig. 3 gives the average assessment, for the whole area only, (the analysis for the UK area is very similar). The results are presented in two slightly different ways; firstly, in Fig. 3a the actual classifications are shown and, secondly, in Fig. 3b the same analysis except that each mark occurring after a 'C' classification is marked down to a 'C'. Thus, Fig. 3a includes forecasts which become fortuitously correct after the occurrence of a major error, whilst Fig. 3b excludes these cases.

These analyses emphasize the overall similarity of performance of the models, and the deterioration in the accuracy of the forecasts from about Day 3 to Day 5. The deterioration from Day 5 to Day 7 is less marked as the number of forecasts correct by chance begins to intrude.

Fig. 4 represents the percentage of occasions when forecasts were classified

"misleading in some important respect", subdivided as in Fig. 3. Perhaps the most interesting feature is the sharp increase in the number of misleading forecasts between Days 3 and 4.

6. Conclusions.

This preliminary examination of the two forecast models has led to the following conclusions:-

a) The two models often develop the synoptic situation in markedly different ways and one may give good guidance on occasions when the other does not. On other occasions both may be misleading in their indications. On average, however, there is little significant difference in the number of occasions when each model gives reliable guidance to a forecaster.

b) Each model has distinct characteristics. Many of these have been identified and some, already known, have been confirmed. Knowledge of these characteristics is essential for the correct interpretation of the model output.

c) Further work on the comparison of these model forecasts should take account of the suggestions listed at Appendix 'C'.

REFERENCES

ECMWF 1977 A model for medium-range weather forecasts - Adiabatic formulation. ECMWF Technical Report No 4.

1979a Monthly Report on ECMWF's Operational Models' Performance. ECMWF Research Department, Technical Memorandum No. 9, 1979 - (September 1979).

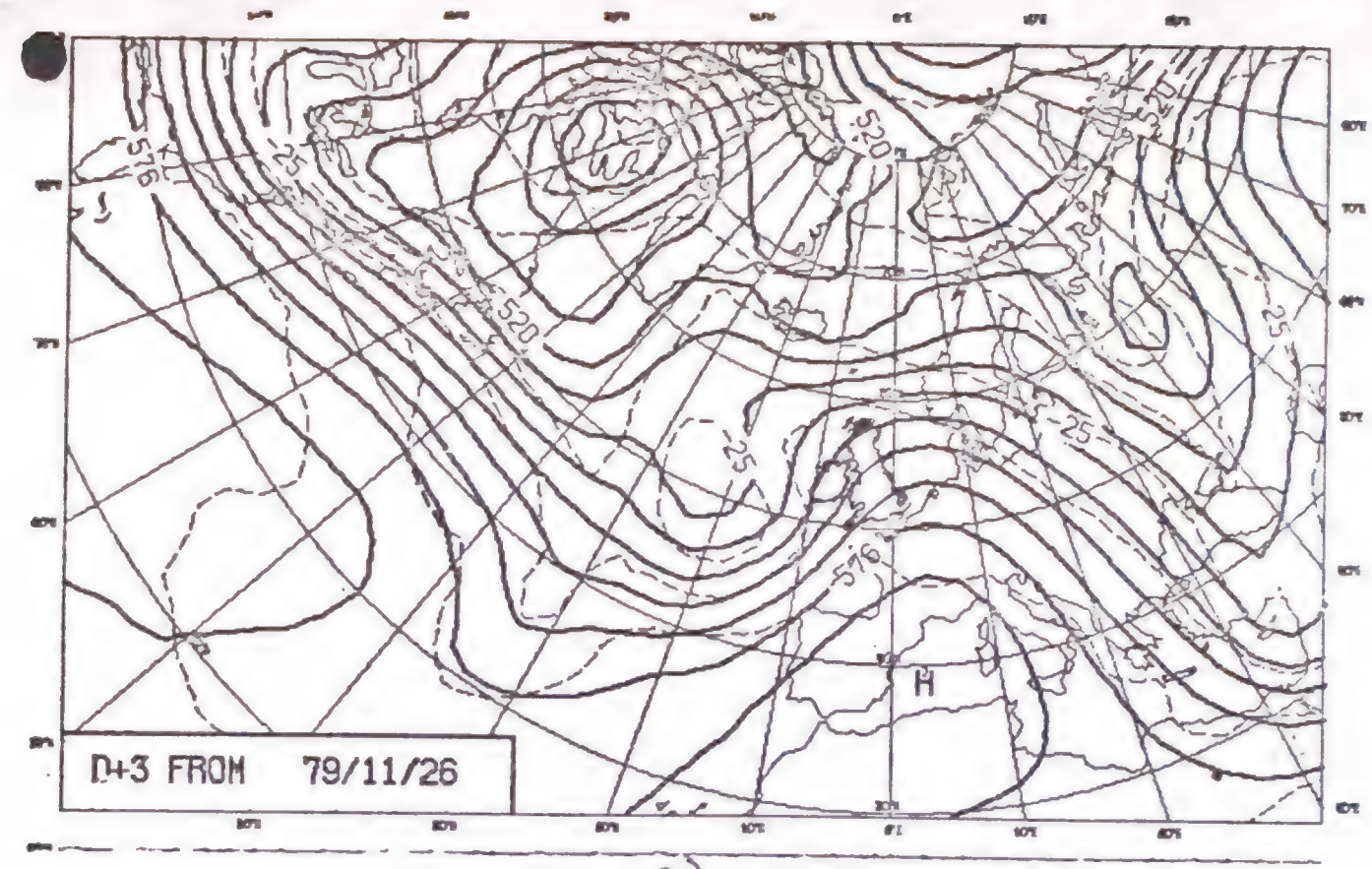
1979b ECMWF Model - Parameterization of sub-grid scale processes. ECMWF Technical Report No. 10.

Burridge D M and Gadd, A J 1977 The Meteorological Office Operational 10-level Numerical Weather Prediction Model. (December 1975) Scientific Paper No 34. H.M.S.O. London.

Meteorological Office 1978 Some characteristics of numerical forecasts in general and the 10-level model in particular. Meteorological Office College. Notes for Senior Meteorologists' Course.

TABLE 1 - A summary of the characteristics of the Octagon and ECMWF medium range forecasts.

	Model	
	Octagon	ECMWF
Very small features handled well	NO	NO
500 mb flow becomes too zonal	YES	NO
" " " " " meridional	NO	YES
" " " " " weak	YES	NO
" " " " " strong	NO	-
Central pressure of lows not deep enough	YES	NO
" " " " too deep	NO	YES
Developing lows fail to turn left	YES	YES
Good with trough disruption	YES	-
Good with changes of type	YES	NO
Fills old lows too quickly	YES	NO
Weakens old highs too quickly	YES	-
Often runs 1 day slow by Day 6	YES	-
850 mb temperatures too low south of 40°N	YES	YES
500 mb contours too low south of 40°N	YES	YES
850 mb temperatures too high in troughs	YES	-
Ridge axes too cold at 850 mb	YES	NO
New lows off US deepen quickly enough	NO	YES
New lows in Atlantic absorbed by parent low	YES	NO
Parent low absorbed by new lows	NO	YES
Low circulations too small	YES	NO
" " " large	NO	YES
Tracks of systems too far south	-	YES
500 mb jet often too far south	-	YES
Mediterranean depressions handled well	YES	NO
Cold air incursion well timed	-	YES
Occasional inconsistent surface in upper patterns	NO	YES
Handles cut-off lows well	NO	-



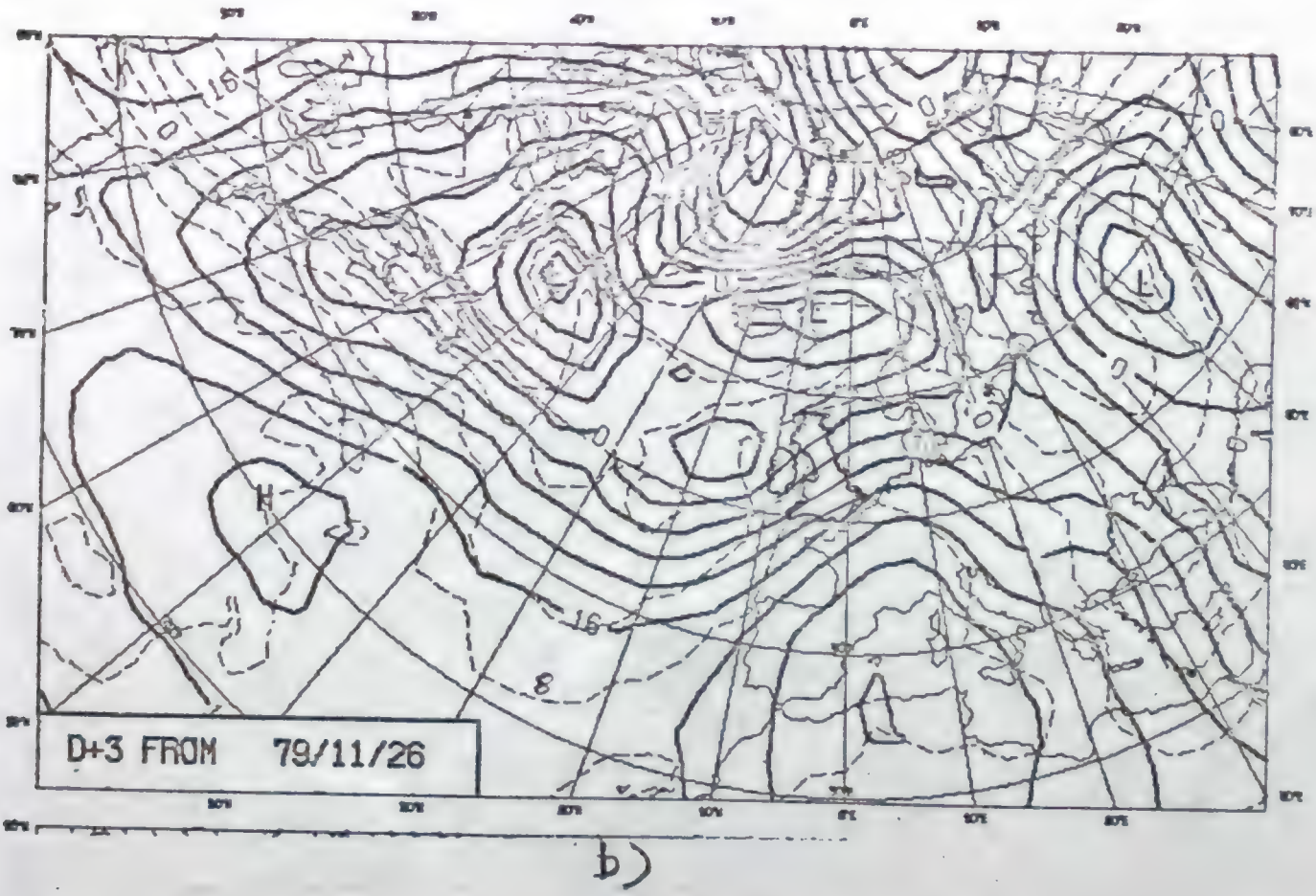


Fig 1 Specimen forecast from ECMWF for Day 3 from 26 November 1979

a) 500mb prognostic contours and isotherms
b) 1000mb prognostic contours and 850mb isotherms

Whole Area

Surface

	Day 1	2	3	4	5	6	7
A	24/24	23/21	13/13	9/9	3/6	4/4	4/-
B	0/0	0/2	9/9	9/7	9/13	7/11	2/-
C	0/0	1/1	2/2	6/8	12/5	13/9	18/-

U.K. Area

Surface

	Day 1	2	3	4	5	6	7
A	24/24	13/20	14/12	10/7	3/9	6/4	5/-
B	0/0	0/3	5/10	8/11	9/8	4/13	4/-
C	0/0	1/1	5/2	6/6	12/7	14/7	15/-

EC/MO

EC = ECMWF Model
MO = Met.O. Octagon Model

500 mb

	Day 1	2	3	4	5	6	7
A	24/24	23/23	15/11	12/10	7/3	6/1	4/-
B	0/0	1/0	7/12	6/9	11/12	4/10	5/-
C	0/0	0/1	1/1	6/5	6/9	14/13	15/-

500 mb

	Day 1	2	3	4	5	6	7
A	24/24	22/22	15/12	12/9	7/6	5/4	6/-
B	0/0	2/1	7/12	6/10	11/13	7/10	3/-
C	0/0	0/1	2/0	6/5	6/5	12/10	15/-

Fig. 2. Classification of medium-range forecasts. Based on 24 forecasts up to 11 February 1980

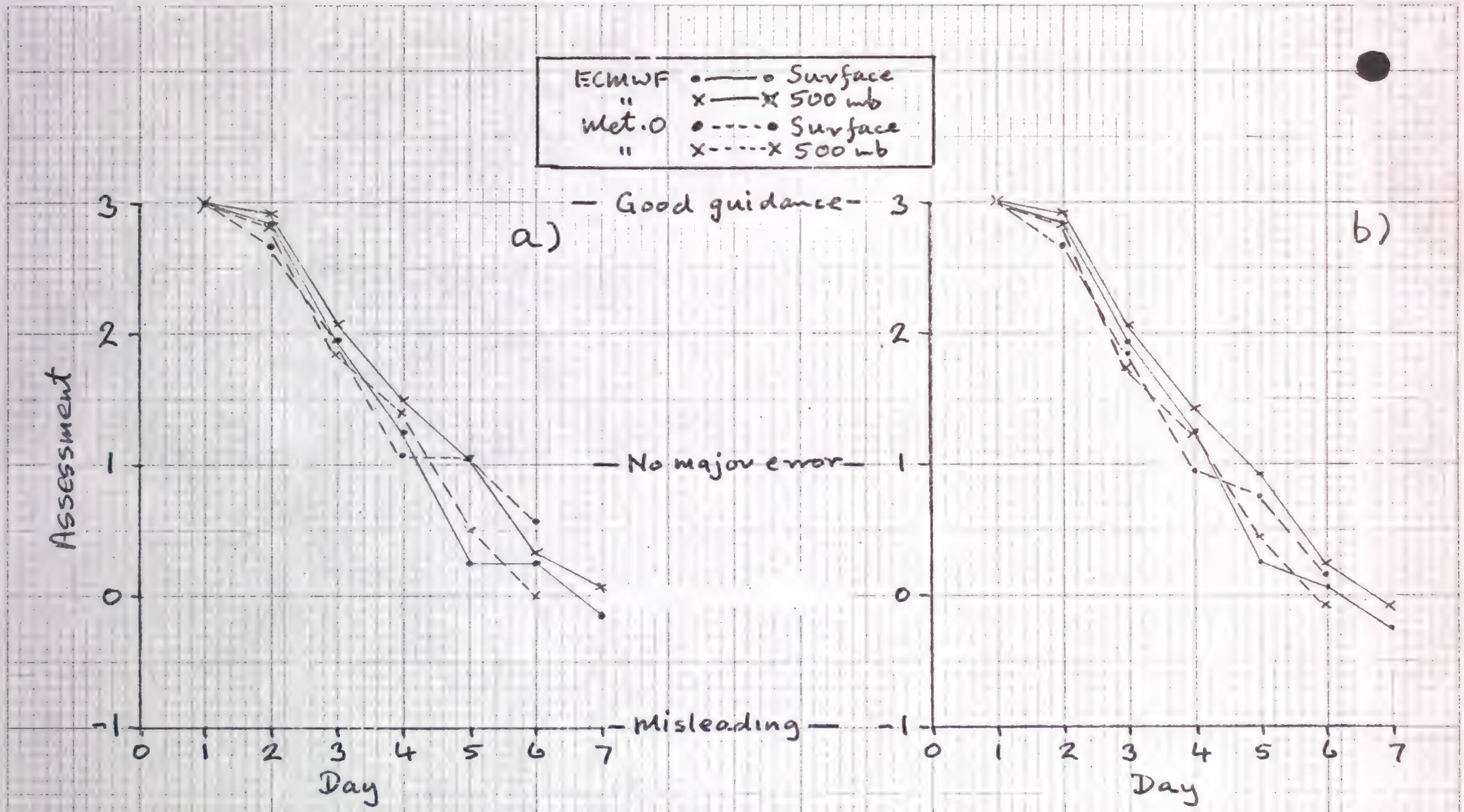


Fig. 3. Assessment of medium range forecasts, whole area only.
a) As classified
b) After first "C" classification, subsequent classifications marked down to "C".

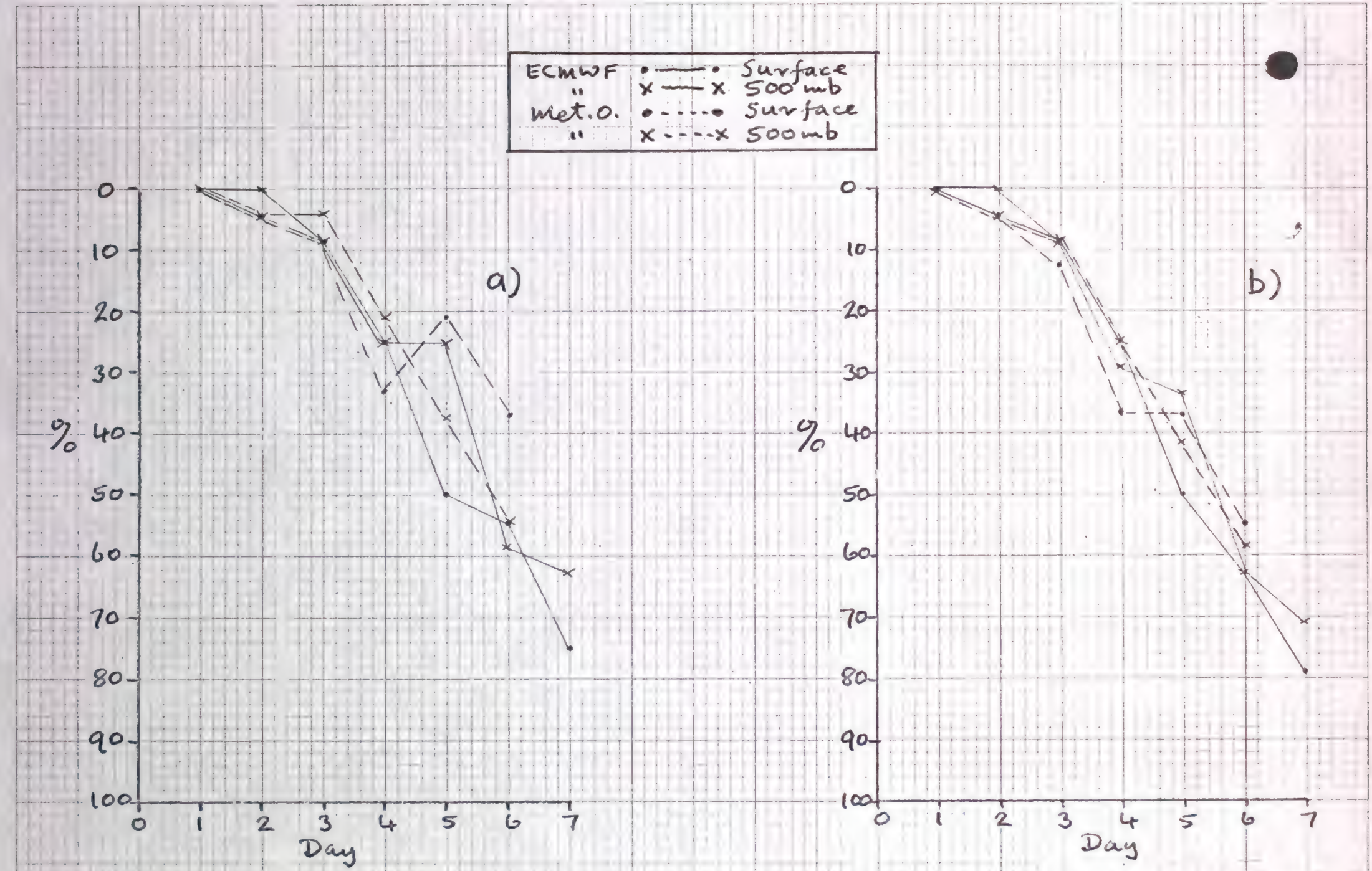
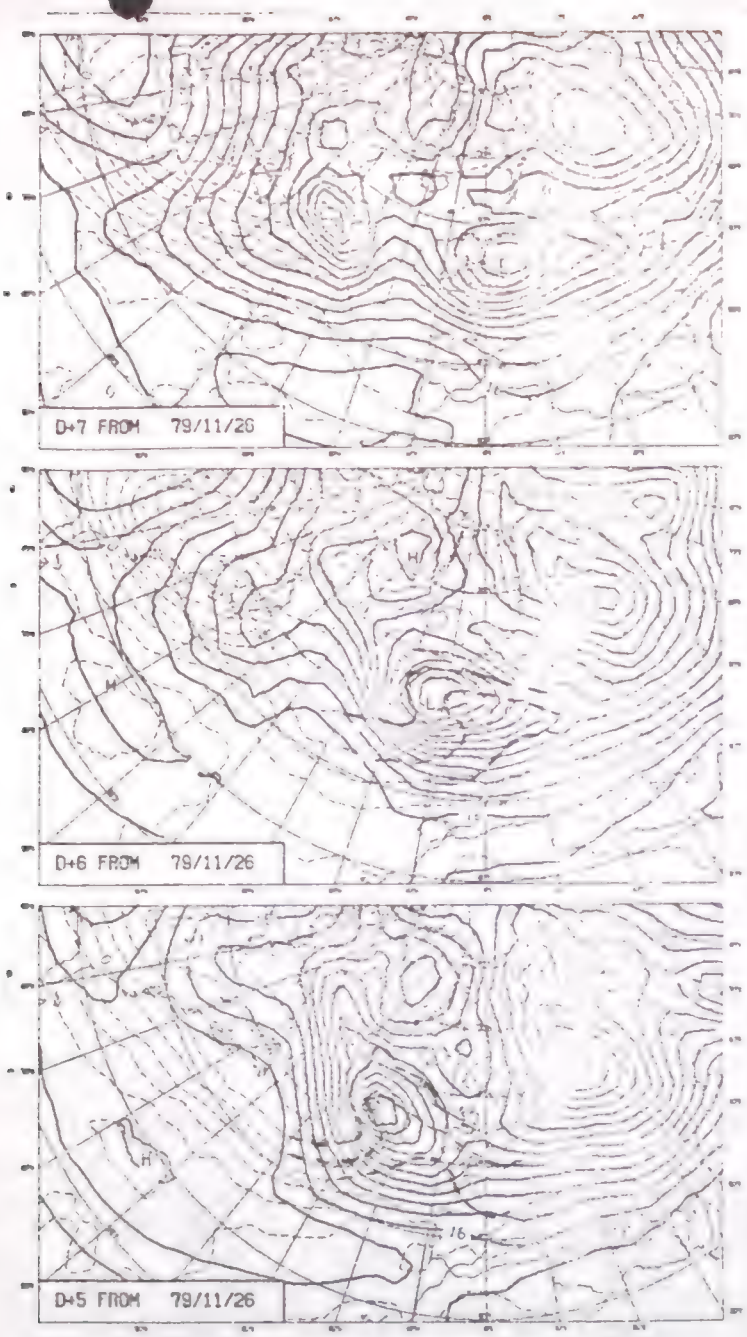


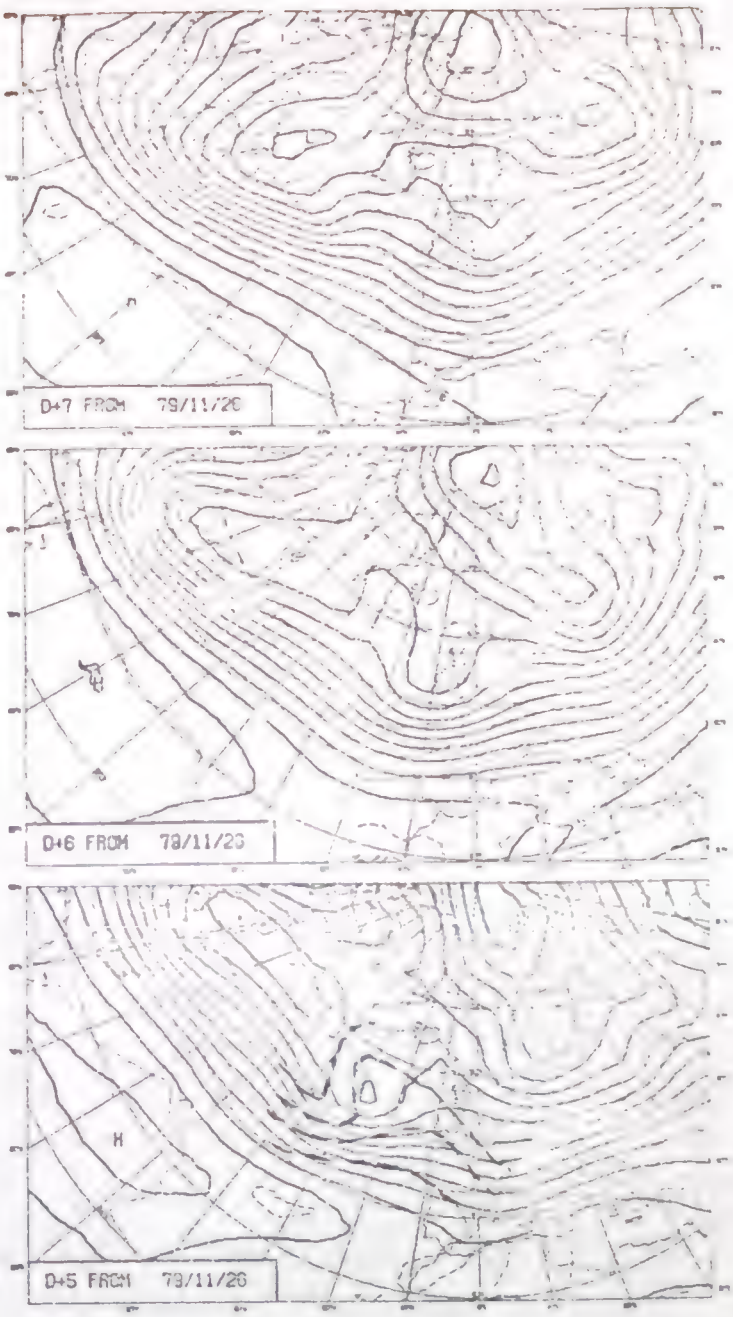
Fig. 4. Percentage of occasions when forecasts were classified as "misleading in some important respect" whole area only.
a) As classified
b) After first "c" classification, subsequent classifications marked down to "c".

Appendix A



ECMWF 1000 MB ANALYSIS AND 12Z FORECAST FIELDS FROM 12Z 26/11/79
CONTOUR INTERVAL 40DAM(THICK LINES), 5K(DASHED LINES)

1000mb



ECMWF 500 MB ANALYSIS AND 12Z FORECAST FIELDS FROM 12Z 26/11/79
CONTOUR INTERVAL 8DAM(THICK LINES), 5K(DASHED LINES)

500mb

Forecasts for Days 5, 6 and 7 indicate that cold air is penetrating to the south of the surface centre and warm air to the east and north of it. The 1000–500mb thermal wind over the depression centre is probably light and from a southerly point. Also, at Days 5 and 6 the 1000mb and 500 centres are co-incident, yet the model predicts the continued rapid movement of the depression centre to the east. In fact this depression had turned to the left earlier and passed between Iceland and Greenland.

An example of the predicted movement of a depression which does not accord well with its structure.

Appendix "B"

Assessment of ECMWF 7-day forecasts and Met O Octagon 6-day forecasts

Guidance Value*

Day 0= 3-12-79

DAY	N.Atlantic and Europe				United Kingdom Area			
	ECMWF		Octagon		ECMWF		Octagon	
	1000 mb	500 mb	Surface	500 mb	1000 mb	500 mb	Surface	500 mb
1	A	A	A	A	A	A	A	A
2	A	A	A	A	A	A	A	A
3	B	A	B	B	C	A	C	B
4	C	C	C	B	C	B	C	B
5	C	C	C	C	C	B	B	B
6	C	C	C	C	C	C	C	C
7	C	C	-	-	C	C	-	-
8								
9								
10								

Notes:

At 500mb short wave troughs and ridges crossed the Atlantic and moved into Europe, but a major ridge developed from the U.K. to Iceland by Day 4 with a cut-off high forming east of Iceland. This in turn was associated with a plunge of cold air over Scandinavia. At the surface a mid-Atlantic depression moved northeastwards to south of Iceland by Day 5 and decayed. Two new depressions from Newfoundland moved very rapidly across the Atlantic with storm force surface winds and crossed the U.K. by Day 7. The more easterly track of the new depressions was influenced by the anticyclone under the upper ridge blocking the track to the northeast. Cold air affected all of Scandinavia from Day 4 with a broad cold eastsoutheasterly airstream flowing from the Baltic to Greenland. The two models predicted events quite well up to about Day 3, but neither forecast the high to the east of Iceland and the new depression tracks along a more southerly latitude. Thus both models predicted mild weather over Scandinavia instead of the cold spell which occurred.

Met O 11
Date: 13-12-79

[signature]
AD Met O(FR)

*The guidance value of the forecasts is assessed on the scale given in C.F.O. Standing Instruction No.A.168

A - Good guidance
B - Did not lead to any major error over the area
C - Misleading in some important aspect

Appendix B (Contd)

Assessment of ECMWF 7-day forecasts and Met O Octagon 7-day forecasts

Guidance Value*

Day 0= 28-1-80

DAY	N.Atlantic and Europe				United Kingdom Area			
	ECMWF		Octagon		ECMWF		Octagon	
	1000 mb	500 mb	Surface	500 mb	1000 mb	500 mb	Surface	500 mb
1	A	A	A	A	A	A	A	A
2	A	A	A	A	A	B	A	A
3	B	B	B	B	A	B	A	B
4	A	A	A	B	A	A	A	B
5	B	A	B	C	B	B	B	B
6	A	A	A	C	A	B	A	C
7	A	A	A	C	A	A	B	B
8								
9								
10								

Notes: At 500mb a cold pool remained near Newfoundland during the period and another persisted over Scandinavia. The mainly westerly flow to the south of these features was disturbed by short-wave troughs and ridges moving east in association with surface depressions. These depressions were produced as secondary or breakaway lows from the main Newfoundland depression and these smaller features crossed the Atlantic in rapid succession to pass over the U.K., giving disturbed weather with mainly easterly winds over Scotland and westerly winds over southern England. Both models predicted the correct track of these depressions up to Day 7 although the ECMWF model tended to overdevelop some features and the Octagon model underestimated the speeds of movement.

An upper high over Greenland moved slowly south whereas both models forecast a movement to the west. Also, another upper high over North Russia was predicted by the Octagon model to move west and displace the Scandinavian cold pool to the south. The high persisted with little movement and strong southerly winds developed from the Black Sea to northern Russia, an event more correctly predicted by the ECMWF model.

Met O 11
Date: 8-2-80

AD Met O(FR)

*The guidance value of the forecasts is assessed on the scale given in C.F.O. Standing Instruction No.A.168

A - Good guidance
B - Did not lead to any major error over the area
C - Misleading in some important aspect

Appendix B (Contd)

Assessment of ECMWF 7-day forecasts and Met O Octagon 6-day forecasts

Guidance Value*

Day 0= 14-1-80

Note: The Octagon model is now being run experimentally to Day 7 each Monday for comparison with the ECMWF model.

	N.Atlantic and Europe				United Kingdom Area			
	ECMWF		Octagon		ECMWF		Octagon	
DAY	1000 mb	500 mb	Surface	500 mb	1000 mb	500 mb	Surface	500 mb
1	A	A	A	A	A	A	A	A
2	A	A	A	A	A	A	A	A
3	A	A	B	B	A	A	B	B
4	A	A	C	C	A	A	C	B
5	B	B	C	C	B	A	C	B
6	B	C	C	C	B	B	B	C
7	C	C	C	C	A	A	C	C
8								
9								
10								

Notes:

An upper ridge over the Atlantic swung southeastwards and cut off an upper high over the U.K. on Day 3. This upper high moved into Europe, displacing the pre-existing cold pools. A plunge of cold air from Greenland between Day 2 and Day5 formed a deep upper trough near the U.K., cutting-off to a cold pool on Day 7. A short-wave trough from Canada moved southeastwards to reinforce the cold pool.

The surface anticyclone associated with the upper ridge moved into Europe to allow cold air to cross the U.K. on Day 6. A small wave near Newfoundland, associated with the upper short-wave trough, sped rapidly across the Atlantic to develop into a major occluding depression over the Irish Sea on Day 7.

Both models forecast developments well to Day 3 but the Octagon was by then showing signs of slowing down. The EC model was not keeping pace with developments by Day 4 when the plunge of cold air into Biscay was underforecast. Neither model predicted the developing wave from Newfoundland but the EC model forecast an earlier depression to be over the U.K. on Day 7, coincident with the position of the new depression at that time, whilst the Octagon model suggested only weak low pressure areas near the U.K..Ridge development in the Atlantic on Days 6 and 7 was forecast better by the Octagon model than by the EC model.

Met O 11
Date: 24-1-80

AD Met O(FR)

*The guidance value of the forecasts is assessed on the scale given in C.F.O. Standing Instruction No.A.168

A - Good guidance
B - Did not lead to any major error over the area
C - Misleading in some important aspect

Suggestions for the verification of medium-range forecasts.

The suggestions listed hereunder have been received from individuals, usually during the weekly discussions of the medium-range forecasts. There is as yet no general agreement on which suggestions should be adopted.

a) Use four classes of assessment rather than three (Jenkinson)

b) Prepare a questionnaire for completion on Day 0 of the weather prospects of Day 1 to 7, so that no later information is available during the interpretation of the forecast charts (AD Met 0(CF) and Minhinick).

c) Make as much use as possible of ECMWF verifications (Riddaway).

d) Devise a skill score method to evaluate the forecasts with the present method of A, B and C classifications. (Ireland).

e) Keep a check on the 1000-500 mb thickness over a portion of the U.K. This is of interest because it is directly related to the general level of surface temperature. (Riddaway).

f) Consideration should be given to sequences of weather or weather type, to distinguish between timing and developmental errors. (AD Met 0(SC).

g) Use a sequence verification scheme of three types, e.g. rain, showers or dry to produce a time sequence for a location or area. A colour code might be helpful in drawing attention to correct sequences of weather, but wrong timings. (Riddaway).

h) The BADS (Basic data set) for the day on which the forecast was made could be made available. (Riddaway).

i) Recovery of archived data for checking forecast details by T.S.O. could be arranged using Met O 22 software. (Weller).

j) Show a continuity chart of a selected 500 mb contour line. (Riddaway).

k) Look for correct advection with incorrect transient features, and correct transient features with incorrect advection. (Little).

l) Use a score of 100 for 'C' marking and all markings following a 'C'. The average will then give the percentage of occasions on which the forecasts have broken down before or on the day in question.
(Carpenter) - Suggestion adopted.

m) New definitions of the categories have been suggested:-

A - All changes taking place over the forecast period correctly forecast. A forecast for any part of the chart essentially correct.

B - A substantial fraction of the changes correct, but some changes over - or under - estimated by a significant margin, leading to misleading forecasts over some areas of the chart.

C - Most of the changes incorrect. The forecast misleading over large areas and essentially of no value. (Cullen).

n) Mark a third area covering western Europe and eastern Atlantic. This would decrease the number of forecasts marked down to the C category because of a major error in one area e.g. Newfoundland, whilst the rest of the area was correct. (Findlater).

o) In addition to the assessments of the overall performance of the models it might be worth assessing particular weather elements, e.g. wind velocity, at selected locations using the A, B and C classification (AD Met O(FR)).

Assessment of ECMWF 7-day forecasts
and Met O Octagon 6-day forecasts

Appendix D

Guidance Value*

Day 0= 8·10·79

DAY	N.Atlantic and Europe				United Kingdom Area			
	ECMWF		Octagon		ECMWF		Octagon	
	1000 mb	500 mb	Surface	500 mb	1000 mb	500 mb	Surface	500 mb
1	AAAAA AA 3·0	AAAAA AA 3·0	AAAAA AA 3·0	AAAAA AA 3·0	AAAAA AA 3·0	BAAAA AA 2·7	AAAAA AA 3·0	BAAAA AA 2·7
2	AABAB AA 2·4	AABAB BA 2·1	AAAAB AA 2·7	AABAB AA 2·4	ABBAA AA 2·4	BAAAB AA 2·4	CAAAA AA 2·4	BABAB BA 1·9
3	CACAC AB 1·0	CACBB BA 1·0	CACAC AB 1·0	CBCCB BB 0·1	ABBAB AB 1·9	CABAB AA 1·9	CABAB BB 1·3	CBCBB BB 0·4
4	BBBBC BB 0·7	CBCBC BA 0·4	BBCCC BB 0·1	CBCCC BB -0·1	BABAB AB 1·9	AABBB BA 1·9	CBCCC BB -0·1	CCCCC BB -0·4
5	CCCCC CB -0·7	CCCBC CB -0·4	CBCCC CB -0·4	BBCCC BB 0·1	CCCCC CB -0·7	CBCCC BB -0·1	CCCCC CB -0·7	CCCCC BB -0·4
6	CCCCC CC -1·0	CCCCC CB -0·7	CCCCC CC -1·0	BBBCC BB 0·4	CCCCC CC -1·0	CCCCC CB -0·7	BBABC BC 0·7	BBABC BB 1·0
7	CCCCC CC -1·0	CCCCC CB -0·7			CCCCC CC -1·0	CCCCC CB -0·7		
8								
9								
10								

Notes:

Marks awarded by the seven assessors and the group average based on the scale A = 3 B = 1 C = -1

Met O 11
Date: _____

AD Met O(FR)

*The guidance value of the forecasts is assessed on the scale given in C.F.O. Standing Instruction No.A.168

A - Good guidance
B - Did not lead to any major error over the area
C - Misleading in some important aspect

Assessment of ECMWF 7-day forecasts
and Met O Octagon 6-day forecasts

Appendix D
(contd.)

Guidance Value*

Day 0= 8·10·79

DAY	N.Atlantic and Europe				United Kingdom Area			
	ECMWF		Octagon		ECMWF		Octagon	
	1000 mb	500 mb	Surface	500 mb	1000 mb	500 mb	Surface	500 mb
1	A / A	A / A	A / A	A / A	A / A	A / A	A / A	A / A
2	A- / A	A- / A	A / A	A- / A	A- / A	A- / A	A- / A	B+ / A
3	B / A	B / B	B / A	B- / B	B+ / A	B+ / A	B / A	B- / B
4	B / A	B- / B	B- / A	C+ / A	B+ / A	B+ / A	C+ / B	C+ / C
5	C / B	C+ / B	C+ / A	B- / A	C / B	C+ / B	C / C	C+ / B
6	C / B	C / B	C / B	B- / B	C / B	C / C	B / C	B / A
7	C / C	C / C	/	/	C / C	C / C	/	/
8								
9								
10								

Notes:

X / Y

X = Assessment by group.
Y = Assessment by single assessor.

Met O 11
Date: _____

AD Met O(FR)

*The guidance value of the forecasts is assessed on the scale given in C.F.O. Standing Instruction No.A.168

A - Good guidance
B - Did not lead to any major error over the area
C - Misleading in some important aspect

ASSESSMENT OF PREDICTED WEATHER OVER ENGLAND

Appendix E

SOUTH OF A LINE FROM BRISTOL CHANNEL TO THE WASH

Date: 10·12·79

Day

				1	2	3	4	5	6	7
Wind Speed	Force	0–3	Light		✓ ✓			✓ ✓	✓	✓
		4–5	Moderate	✓ ✓			✓ ✓			
		6	Strong			✓ ✓				
General Wind Direction			N to E						✓	
			E to S							
			S to W		✓ ✓	✓ ✓	✓ ✓			
			W to N	✓ ✓				✓ ✓		✓
			Variable							
Precipitation			Mainly Dry		✓ ✓			✓		✓
			Showers	✓ ✓			✓ ✓	✓	✓	
			Mainly Wet			✓ ✓			✓	
Maximum Temperature (normal = 8°C)			Above normal		✓ ✓	✓ ✓		✓ ✓	✓	
			Normal	✓ ✓			✓ ✓			
			Below normal						✓	✓

EC / MO – Enter tick as appropriate

Shade in box for verification

Forecaster 'A'

ASSESSMENT OF PREDICTED WEATHER OVER ENGLAND

SOUTH OF A LINE FROM BRISTOL CHANNEL TO THE WASH

Appendix E (contd.)

Date: 10·12·79

Day

				1	2	3	4	5	6	7
Wind Speed	Force	0–3	Light							
		4–5	Moderate	✓	✓			✓		✓
		6	Strong			✓	✓			
General Wind Direction			N to E						✓	
			E to S						✓	
			S to W	✓	✓	✓	✓			
			W to N	✓				✓		✓
			Variable							
Precipitation			Mainly Dry							
			Showers	✓			✓	✓	✓	✓
			Mainly Wet		✓	✓				
Maximum Temperature (normal = 8°C)			Above normal	✓	✓	✓	✓		✓	
			Normal					✓		
			Below normal					✓	✓	✓

EC / MO – Enter tick as appropriate

Shade in box for verification

Forecaster 'B'